Mechanical Engineering

Chair and Associate Professor: Perez
Professors: Bosworth, Schoen, Williams
Associate Professor: Wabrek
Assistant Professor: Sebastian
Senior Lecturer: Hofle

Master of Science in Measurement and Control Engineering

The master’s degree program in Measurement and Control Engineering is designed to provide advanced study (analytically, computationally, and experimentally) in measurements, modeling, simulation, robotics, and control, intelligent, nonlinear, optimal, and robust control. This program prepares the student for advanced placement in the measurement and control engineering field in industry, research, or development areas. Additionally, this program provides a suitable base for entrance into a doctoral program in a field related to mechanical engineering. The program is offered both at the Pocatello and the Idaho Falls campuses, primarily through the use of telecommunications/distance learning, which includes partial in-class instruction.

Goals

• Enhance the knowledge of graduates in advanced concepts of measurement, control, signal processing, engineering mathematics, computation, and other related areas.
• Increase the ability of graduates to synthesize and apply these advanced concepts to develop realistic measurement and control engineering designs and to solve identified problems, designing strategies for implementing them safely, ethically, and effectively.
• Enhance the ability of graduates to effectively communicate these concepts both in oral and written formats.

Master of Science in Mechanical Engineering

The master’s degree program in Mechanical Engineering is designed to provide advanced study (analytically, computationally, and experimentally) in thermodynamics, fluids, heat transfer, energy systems, vibrations, engineering mechanics, and their associated measurement systems. This program prepares the student for advanced placement in the mechanical engineering field in industry, research, or development areas. Additionally, this program provides a suitable base for entrance into a doctoral program in a field related to Mechanical Engineering. The program is offered both at the Pocatello and Idaho Falls campuses, primarily through the use of telecommunications/distance learning, which includes partial in-class instruction.

Goals

• Enhance the knowledge of graduates in advanced concepts of thermodynamics, fluids, heat transfer, energy systems, vibrations, engineering mechanics, measurements, and engineering mathematics.
• Increase the ability of graduates to synthesize and apply these advanced concepts to develop realistic mechanical engineering designs implementing them safely, ethically, and effectively.
• Enhance the ability of graduates to effectively communicate these concepts both in oral and written forms.

Master of Science in Measurement and Control Engineering

Program Director: Ken Bosworth

Admission Requirements

The student must meet all criteria for admission and then apply to the Graduate School. In addition, official Graduate School record Examination (GRE) score reports are required for all applicants, with a score equal or above the upper 65th percentile on the Quantitative Reasoning area being required for admission.

General Requirements

With the assistance of the Mechanical Engineering and/or Electrical Engineering faculty, the student shall select an initial advisor during the first semester of residence to help in planning a program of studies and research. The student must also complete a Plan of Study and form a complete advisory committee by the time six credits of course work have been completed.

30 credit hours are required to complete the M.S. degree (at least 50% of the credits should be at the 6600 level). Approximately half of the credits are engineering and technical electives, subject to the approval of the student’s advisory committee. The Thesis or Special Project should consist of study and research that complements the course work selected.

Required Courses (30 credits)

The following courses are required of every student receiving the master’s degree in Measurement and Control Engineering covered by the abbreviated list.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 5521</td>
<td>Advanced Engineering Mathematics I</td>
<td>3</td>
</tr>
<tr>
<td>MCE 6642</td>
<td>Advanced Control Systems</td>
<td>3</td>
</tr>
<tr>
<td>MCE 6643</td>
<td>Advanced Measurement Methods</td>
<td>3</td>
</tr>
<tr>
<td>Approved Engineering Electives</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Approved Technical Electives</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>ENGR 6650</td>
<td>Thesis</td>
<td>6</td>
</tr>
<tr>
<td>OR One additional elective course</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AND ME 6660</td>
<td>Special Project ¹</td>
<td>3</td>
</tr>
</tbody>
</table>

Total Credits: 30

¹ Students desiring to do the non-thesis option must have a minimum of two years industry experience. In place of the 6-credit thesis, the non-thesis option consists of a 3-credit Special Project in addition to a 3-credit course. At the completion of the Special Project, the student will be required to present an oral presentation/defense of the Project.

Master of Science in Mechanical Engineering

Program Director: Alba Perez Gracia

Admission Requirements

All applicants for the M.S. in ME program must have a Bachelor of Science degree in engineering, physical sciences, mathematics or a closely related field, and must meet Idaho State University Graduate School M.S. admission requirements. In addition, official Graduate Record Examinations (GRE) score
reports are required for all applicants, except those with a B.S. degree in an Engineering discipline from ISU, with a score equal or above the 65th percentile on the Quantitative Reasoning area being required for admission.

General Requirements
With the assistance of the Mechanical Engineering faculty, the student shall select an initial advisor during the first semester of residence to help in planning a program of studies and research. The student must also complete a Plan of Study and form a complete advisory committee by the time six credits of course work have been completed.

30 credit hours are required to complete the M.S. degree (at least 50% of the credits should be at the 6600 level). Approximately half of the credits are engineering and technical electives, subject to the approval of the student’s advisory committee. The Thesis or Special Project should consist of study and research that complements the course work selected.

Required Courses (30 credits)

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Select at least 3 credits (1 course) from advanced mathematics from the following list:</td>
<td>3</td>
</tr>
<tr>
<td>MATH 5506</td>
<td>Advanced Linear Algebra</td>
<td></td>
</tr>
<tr>
<td>MATH 5521</td>
<td>Advanced Engineering Mathematics I</td>
<td></td>
</tr>
<tr>
<td>MATH 5522</td>
<td>Advanced Engineering Mathematics II</td>
<td></td>
</tr>
<tr>
<td>MATH 5542</td>
<td>Introduction to Numerical Analysis II</td>
<td></td>
</tr>
<tr>
<td>MATH 5565</td>
<td>Partial Differential Equations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Select at least 9 credits (3 courses) from the following list:</td>
<td>9</td>
</tr>
<tr>
<td>ME 6607</td>
<td>Advanced Thermodynamics</td>
<td></td>
</tr>
<tr>
<td>ME 6635</td>
<td>Transport Phenomena</td>
<td></td>
</tr>
<tr>
<td>ME 6676</td>
<td>Conduction Heat Transfer</td>
<td></td>
</tr>
<tr>
<td>ME 6640</td>
<td>Advanced Vibrations</td>
<td></td>
</tr>
<tr>
<td>MCE 6643</td>
<td>Advanced Measurement Methods</td>
<td></td>
</tr>
<tr>
<td>MCE 6644</td>
<td>Advanced Kinematic Design</td>
<td></td>
</tr>
<tr>
<td>ME 6648</td>
<td>Robotic Grasping/Manipulation</td>
<td></td>
</tr>
<tr>
<td>ME/CE 6665</td>
<td>Finite Element Methods</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Additional coursework, up to 12 credits (4 courses) of approved electives</td>
<td>12</td>
</tr>
<tr>
<td>Thesis</td>
<td>ME 6650 Thesis (6 credits)</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>OR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>One additional elective course</td>
<td></td>
</tr>
<tr>
<td>AND</td>
<td>ME 6660 Special Project</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total Credits</td>
<td>30</td>
</tr>
</tbody>
</table>

1 Approved by Major Advisor.

2 Students desiring to do the non-thesis option must have a minimum of two years of industry experience, or a previous graduate degree (MS or PhD) in an engineering discipline that included the completion of a thesis or dissertation. In place of the 6-credit thesis, the non-thesis option consists of a 3-credit Special Project in addition to a 3-credit course. At the completion of the Special Project, the student will be required to do an oral presentation/defense of the Project.

Doctor of Philosophy in Engineering and Applied Science
A doctoral program in Engineering and Applied Science, administered through the College of Science and Engineering, is available to Engineering students. The complete program description is provided elsewhere in the College of Science & Engineering section of the Graduate Catalog.

Measurement/Control Engr Courses

MCE 5599 Experimental Course: 1-6 semester hours.
This is an experimental course. The course title and number of credits are noted by course section and announced in the class schedule by the scheduling department. Experimental courses may be offered no more than three times. May be repeated.

MCE 6640 System Modeling Identification and Simulation: 3 semester hours.
Model development, off-line and on-line identification methods for engineering systems, diagnostic tests and model validation and analog and digital simulation methods. PREREQ: ME/EE 5573 or equivalent.

MCE 6642 Advanced Control Systems: 3 semester hours.
State space analysis and design to include stability, controllability, observability, realizations, state feedback and estimation. PREREQ: ME 5573/EE 5573 or ME 4473/EE 4473.

MCE 6643 Advanced Measurement Methods: 3 semester hours.
Instrumentation systems used in detection and signal conditioning of thermal-hydraulic process variables, radiation including lasers, and electrical and mechanical properties of materials. PREREQ: ME 5505 or ME 4405.

MCE 6644 Measurements and Controls Laboratory: 3 semester hours.
Work with measuring systems for a variety of process variables. Investigation of characteristics of various process control components and systems. Transient and stationary conditions will be included. PREREQ: MCE 6642 and MCE 6643.

MCE 6645 Advanced Control Theory and Applications: 3 semester hours.
Topics selected from advanced control theory and applications, depending upon the interest of students and faculty. May be repeated for credit when topics vary. PREREQ: MCE 6642 or permission of instructor.

MCE 6646 Intelligent Control Systems: 3 semester hours.
Analysis and design of systems using intelligent techniques such as neural networks, fuzzy logic, genetic algorithms, and artificial intelligence. PREREQ: Permission of instructor.

MCE 6647 Nonlinear Control Systems: 3 semester hours.
Phase plane analysis. Lyapunov stability. Describing functions. Singular perturbation and feedback linearization. PREREQ: MCE 6642 or permission of instructor.

MCE 6649 Robotics and Automation: 3 semester hours.
Robotic manipulator kinematics, dynamics, trajectory planning, sensors, programming and control. The application concepts of robotics in industry will be briefly introduced. PREREQ: MCE 6642.

MCE 6650 Thesis: 1-9 semester hours.
Thesis research must be approved by the student’s advisory committee. Six credits may be used to satisfy the research requirements for the degree. Graded S/U.

MCE 6652 Special Problems: 1-3 semester hours.
Special experimental, computational, or theoretical investigation leading to development of proficiency in some area of engineering. Formal report required. PREREQ: PRIO Project Approval Required by an Engineering Faculty. May be graded S/U. May be repeated.
ME 6653 Optimal Control Systems: 3 semester hours.

ME 6654 Adaptive Control Systems: 3 semester hours.

ME 6656 Robust Control Systems: 3 semester hours.
Analyze and design basic robust controllers using methods for robustness investigation such as nu-analysis and H infinity control algorithms. PREREQ: MCE 6642 or permission of instructor.

ME 6660 Special Project: 1-9 semester hours.
A significant project, involving engineering applications, toward the completion of M.S. program with non-thesis option. Includes a report and oral examination. Graded S/U. May be repeated.

ME 6699 Experimental Course: 1-6 semester hours.
This is an experimental course. The course title and number of credits are noted by course section and announced in the class schedule by the scheduling department. Experimental courses may be offered no more than three times. May be repeated.

MCE 8850 Doctoral Dissertation: 1-24 semester hours.

Mechanical Engr Courses

ME 5505 Measurement Systems Design: 3 semester hours.
Introduction to instrumentation systems analysis and design, including: statistical analysis, system modeling, actuators, transducers, sensor systems, signal transmission, data acquisition, and signal conditioning. PREREQ: MATH 3360.

ME 5506 Measurement Systems Laboratory: 1 semester hour.
Principles of measurement, measurement standards and accuracy, detectors and transducers, digital data acquisition principles, signal conditioning systems and readout devices, statistical concepts in measurement, experimental investigation of engineering systems. Specific, evaluated graduate-level activities and/or performances are identified in the course syllabus. PREREQ: MATH 3360 and EE 2240.

ME 5515 Model Theory: 3 semester hours.
Theory of design and testing of scaled system models. Dimensional analysis with application to physical models. True and distorted models, linear and non-linear models, and analogies. Laboratory work required. PREPREQ: ME 3341 and CE/ME 3350.

ME 5524 Introduction to Robotics: 3 semester hours.
Overview of robotic systems. Kinematics, dynamics and motion planning for serial, parallel, and mobile robots. Motion simulation, control, and programming. Specific, evaluated graduate-level activities and/or performances are identified in the course syllabus. PREREQ: ME 1165 or CS 1181 (for EE students), MATH 2240, PHYS 2211. D

ME 5525 Mechatronics: 3 semester hours.
Basic kinematics, sensors, actuators, measurements, electronics, microprocessors, programmable logic controllers, feedback control, robotics and intelligent manufacturing. Specific, evaluated graduate-level activities and/or performances are identified in the course syllabus. Equivalent to EE 5525. PRE-OR-COREQ: ME 4473 or EE 4473; and PREREQ: MATH 3360.

ME 5535 Computer Simulation: 3 semester hours.
Basic Finite Element Analysis (FEA), Excel and SolidWorks simulation for static and dynamic analysis of mechanical design components, and thermal fluid systems analysis. Specific, evaluated graduate-level activities and/or performances are identified in the course syllabus. PREREQ: ME 4476, ME 4440, permission of instructor. D

ME 5540 Vibration Analysis: 3 semester hours.

ME 5551 Compressible Fluid Flow: 3 semester hours.
Fundamentals of compressible flow and gas dynamics, development of basic principles, practical applications. Techniques developed for isentropic friction, heat addition, isothermal flow, shock wave analysis, propagation, expansion waves, reflection waves. PREREQ: ME 3307 and CE/ME 3341.

ME 5564 Engineering Numerical Techniques: 3 semester hours.
Numerical methods for solving linear and nonlinear systems of equations, data fitting and smoothing, numerical integration and differentiation, initial and boundary value problems, and optimization. Stresses engineering applications and programming projects. Specific, evaluated graduate-level activities and/or performances are identified in the course syllabus. PREREQ: ME 1165 or CS 1181; MATH 2240, MATH 2275, and MATH 3360.

ME 5568 Behavior of Composite Materials: 3 semester hours.
Macro and micromechanical behavior of laminae and laminates bending, buckling and vibration of laminated beams and plates. Equivalent to CE 5568. PREREQ: ENGR 3350.

ME 5573 Mechanical Control Systems: 3 semester hours.
Discrete and continuous time control system design, signal processing, embedded systems. PREREQ: ME 2220, EE 2240, and MATH 3360, or equivalent.

ME 5599 Experimental Course: 1-6 semester hours.
This is an experimental course. The course title and number of credits are noted by course section and announced in the class schedule by the scheduling department. Experimental courses may be offered no more than three times. May be repeated.

ME 6607 Advanced Thermodynamics: 3 semester hours.
Thermodynamic property relationships, gas mixtures, thermodynamic optimization, irreversible thermodynamics, constructual theory, applications towards solar power, power generation, and refrigeration systems. PREREQ: MATH 3360 and ME 4416.

ME 6635 Transport Phenomena: 3 semester hours.
Systematic and parallel treatment of heat transfer, mass transfer, and momentum transfer (viscous flow). PREREQ: ME 4476, ME 3341, and MATH 3360. RECOMMENDED: MATH 5521.

ME 6640 Advanced Vibrations: 3 semester hours.
Vibrational theory of continuous, multiple-degree-of-freedom systems, and random vibrations. Use of advanced numeric techniques. COREQ: ENGR 5521 or MATH 5521. PREREQ: ME 5540 or ME 4440.

ME 6644 Advanced Kinematic Design: 3 semester hours.
Application of kinematic synthesis theory to the design of planar and spatial articulated systems. Finite-position precision synthesis, trajectory and workspace optimization and motion analysis for planar, spherical and spatial open and closed-loop chains. PREREQ: MATH 2240 and ME 3320.
ME 6648 Robotic Grasping/Manipulation: 3 semester hours.
Theoretical issues for multi-fingered robotic hands. Grasp analysis, grasp synthesis, mechanics of manipulation, path planning. Screw theory, twists and wrenches. Study of robotic hands and related sensing devices. PREREQ: MCE 6649 or permission of instructor.

ME 6650 Thesis: 1-9 semester hours.
Thesis research must be approved by the student's advisory committee. Six credits may be used to satisfy the research requirements for the degree. Graded S/U. May be repeated.

ME 6652 Special Problems: 1-3 semester hours.
Special experimental, computational, or theoretical investigation leading to development of proficiency in some area of engineering. Formal report required. PREREQ: PRIO Project Approval Required by an Engineering Faculty. May be graded S/U. May be repeated.

ME 6660 Special Project: 1-9 semester hours.
A significant project, involving engineering applications, toward the completion of M.S. program with non-thesis option. Includes a report and oral examination. Graded S/U. May be repeated.

ME 6665 Finite Element Methods: 3 semester hours.
Introduction to finite element methods applied to linear one- and two-dimensional problems. Application of the concept to specific problems in various fields of engineering and applied sciences. Equivalent to CE 6665. PREREQ: ENGR 3350 and MATH 3360.

ME 6676 Conduction Heat Transfer: 3 semester hours.

ME 6699 Experimental Course: 1-6 semester hours.
This is an experimental course. The course title and number of credits are noted by course section and announced in the class schedule by the scheduling department. Experimental courses may be offered no more than three times. May be repeated.

ME 8850 Doctoral Dissertation: 1-24 semester hours.